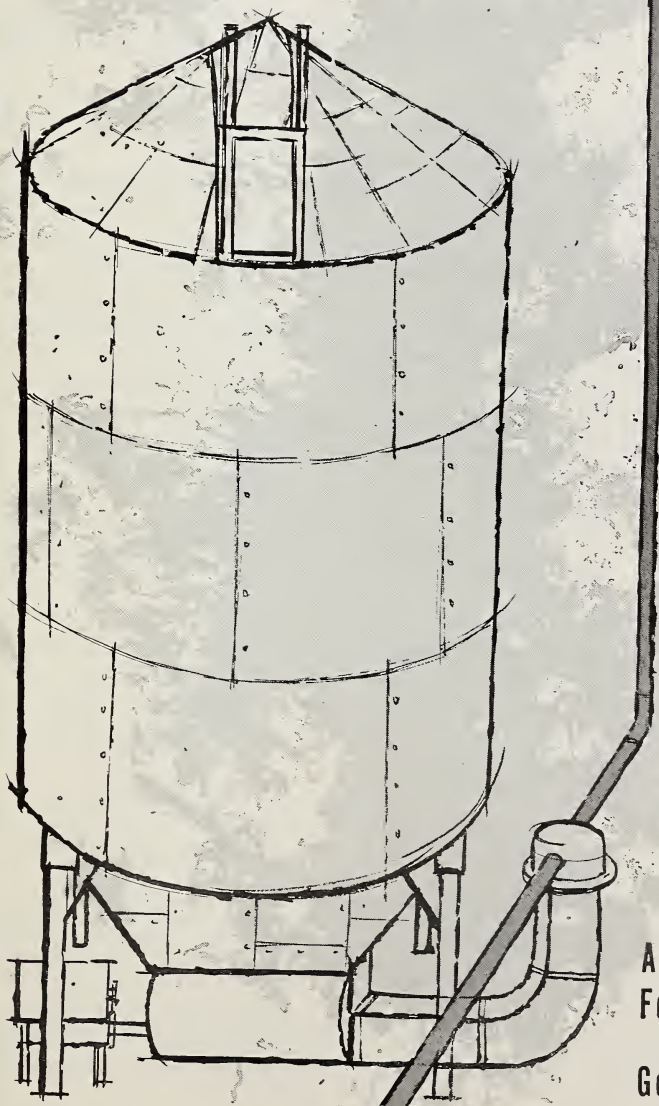
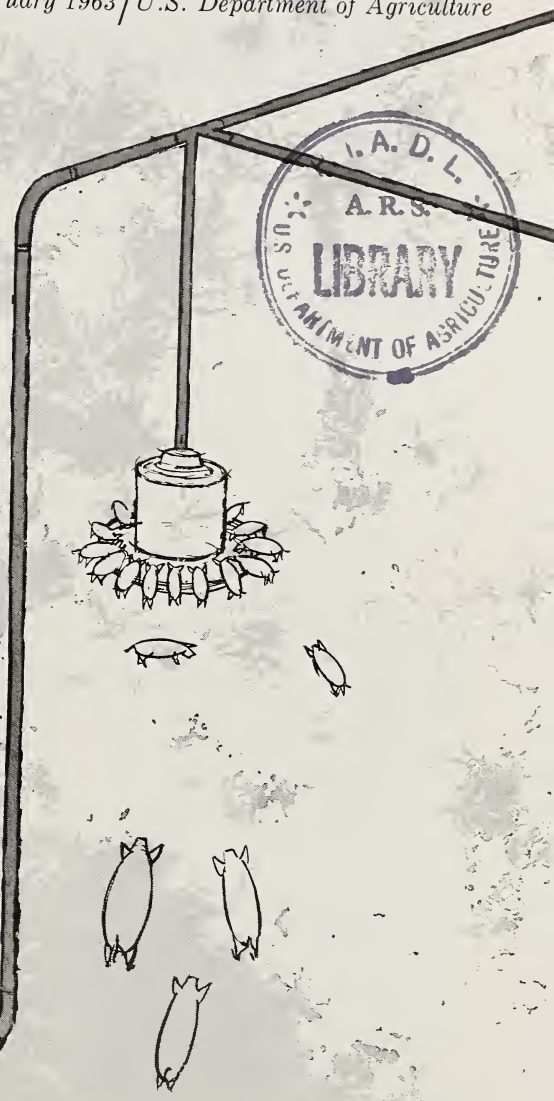
February 1963/U.S. Department of Agriculture

AGRICULTURAL Research





AGRICULTURAL
Research

February 1963/Volume 11, No. 8

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The Air Around Us

Today's enchantment with space makes the study of air used by plant and animal life here on earth tame by comparison. Even so, in our "earthy" atmosphere lies a serious and growing menace to U.S. agriculture. That menace is air pollution.

Air pollutants are costing today's producers of crops, forest and shade trees, and livestock hundreds of millions of dollars a year. As our society becomes more urbanized and mechanized, the impact of these pollutants will multiply in force.

Two of the most damaging pollutants are the smog substances ozone and peroxyacetyl nitrate (PAN). They have caused significant crop losses in recent years in the Los Angeles basin and along the northeastern seaboard. Damage has been detected near practically every metropolitan area, coast to coast.

The challenge offered by this type of pollutant is complex. Whereas earlier recognized pollutants are usually traceable to a few large industrial plants, smog comes from millions of sources in our highly industrialized and mechanized society.

It takes only a fraction of a part per million of either ozone or PAN to damage some vegetation. The pollutants not only damage foliage but may also reduce photosynthesis, increase respiration, induce early leaf drop, retard growth, and cut yield.

Research now underway—good as it is—adds up to little more than a beginning in learning how to combat air pollution.

Our agricultural scientists need to determine the mechanism of action of air pollutants and their effect on metabolic processes. This calls for a study of how genetics and the environment are related to the effect of air pollutant poisons on the organic processes of plants, including forest and shade trees and animals.

There is also need for research on the nature of pollutants . . . on levels of toxicity . . . on the way nutrients and quality of feed are affected . . . on the best methods of surveying damage . . . on the extent agriculture itself contributes to air pollution.

With the knowledge gained from this kind of research, we can then move ahead in developing research techniques and training personnel to combat the growing air pollution menace.

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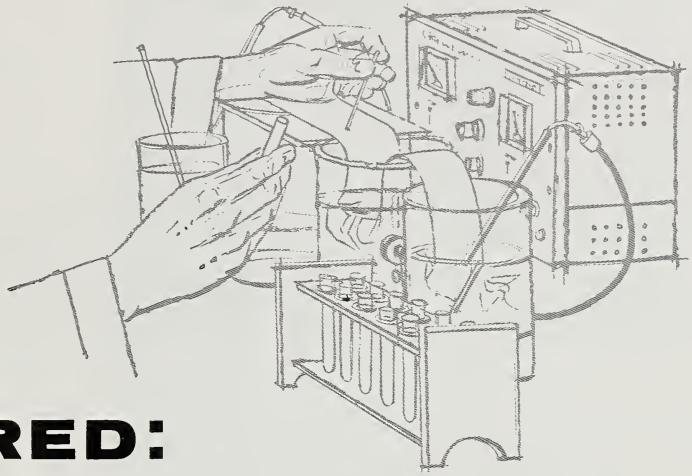


DISCOVERED:

Genetically Controlled Variation in Milk Protein

Finding could lead to improved milk processing and dairy breeding

■ *The complex structure of milk protein and the influence of heredity on protein composition are gradually being revealed by pioneering research to find new uses for dairy products.*

With a fuller understanding of the variations in milk-protein components and their genetic origin, scientists may someday be able through animal breeding to alter the composition of milk to meet our specific requirements. The new knowledge is already helping scientists struggling to improve the stability of fluid milk concentrates and dried whole milk during processing and storage.

ARS scientists have found genetically controlled variations in alpha$_s$-casein—a component of the milk protein casein.

This finding adds another building block to basic knowledge on the complex structure of the protein in milk.

Scientists long believed that casein was a structural entity, that is, it could not be fractionated. Then about 1950, ARS chemists succeeded in separating casein into three components, designated as alpha, beta, and gamma. Later, scientists of the Massachusetts Institute of Technology further separated the alpha component into alpha$_s$-casein and kappa-casein.

Now ARS chemists have found variations in alpha$_s$, and there are indications that the same may be true of the kappa component.

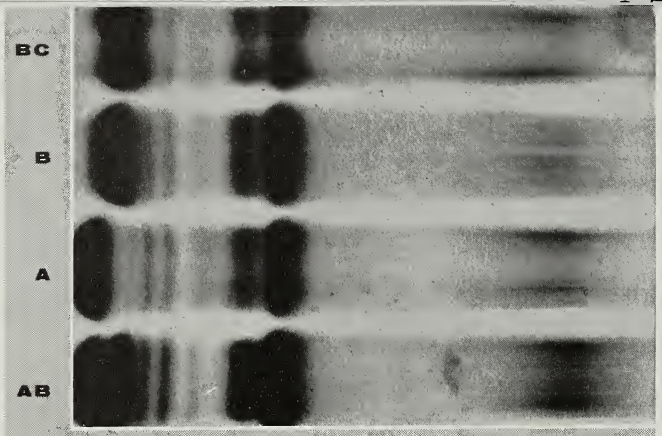
Cooperative work by ARS dairy scientists has tied these alpha-casein variations in milk to the cow's ancestry. British researchers have found genetically controlled variations in the beta component of casein.

The ARS work on alpha$_s$-casein is being done by chemists M. P. Thompson, L. Pepper, and C. A. Zittle at the Eastern utilization research laboratory, near Philadelphia, and geneticist C. A. Kiddy at the Agricultural Research Center, Beltsville, Md.

A clue to the possible significance of the alpha$_s$ and kappa components was uncovered when alpha-casein was added to a solution containing many more calcium ions than are present in fluid milk. The extra calcium allowed alpha$_s$-casein to separate out, leaving a complex mixture whose most important component proved to be kappa-casein. Further study showed that it is the kappa-casein in milk that stabilizes the alpha$_s$-casein and keeps it from forming a sediment. This may prove highly important in research now underway to develop concentrated and dried milks that remain stable in long-term storage.

Milk samples used in these studies were obtained from the Beltsville experimental herd—a good source because records have been kept of the ancestry of each cow. When the chemists analyzed the caseins from these milk samples—using the very sensitive starch-gel electrophoresis technique—they found that the analytical pattern occasionally showed

Turn Page



Migration of droplets of milk casein on a starch-gel material containing urea permits a precise analysis of casein components. In the electrophoresis process, a direct current is applied, causing the components to migrate in the gel and form a pattern. The pattern is then compared with known migrations to identify the components. For example, in the above four patterns (BC, B, A, AB), the bands at the left show four variants of alpha$_s$-casein. Bands at left center are of single beta-caseins. And the streaks at right are characteristic of kappa-casein.

Milk Protein (*Continued*)

two bands, instead of the usual single band, in the alpha$_s$ position. This indicated that the alpha$_s$-casein consisted of two components: One, alpha$_s$-A, had a greater charge than the other, alpha$_s$-B, and hence moved faster in an electrical field.

The two components showed up in 6 of 93 casein samples. All 6 were from the daughters of one Holstein sire. Armed with the clue that this casein characteristic might be genetically controlled, the researchers obtained milk samples from about a hundred other daughters of the same sire in different parts of the country. Analysis of these samples showed the two-component alpha$_s$-casein in about half of them.

The scientists later found that some samples of milk casein had alpha$_s$-casein with a third component, called alpha$_s$-C, which is slower moving in an electrical field than alpha$_s$-B. Thus, they conclude that alpha$_s$-casein in milk can exist in three forms—A, B, and C. Since genes (units of inheritance) always occur in pairs, two forms could occur in the casein of milk from any one cow. Whether the two genes are alike or different depends on the inheritance of the cow. She could produce milk containing A, B, or C only or A and B, A and C, or B and C.

Hundreds of milk samples have been analyzed—principally from Holsteins in Maryland, New York, New Jersey, and Michigan. The scientists found all of the variant combinations of alpha$_s$-casein. B's occurred most frequently, followed by a fair sprinkling of AB's and BC's. Only five AC's and two A's showed up. The C variant appeared in two milk samples from Guernsey cows in Maryland.

Thompson and his associates are now turning their attention to the kappa component of alpha-casein. They believe this component also has a plural makeup that can be traced to a genetic source.☆

Research on feed handling introduces . . .

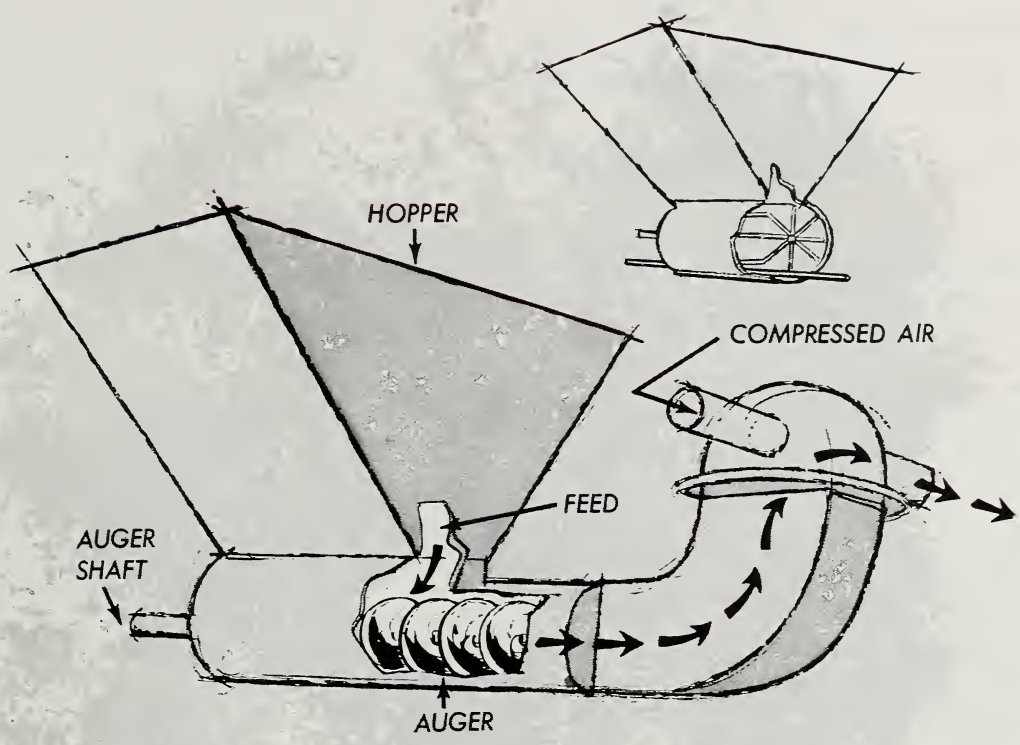
An Auger Injector For Pipeline Feeding

■ Getting feed into an automated pipeline feeding system has been made easier by a new auger-type feed injector.

This device has two primary advantages: It costs considerably less than rotary-valve injectors, now used on most commercial pipeline systems, and it never needs adjusting.

ARS engineers H. B. Puckett and H. H. Klueter, designers of the new injector, say it could be mass-produced for about $100. A rotary-valve injector costs about $700.

Puckett is stationed at Urbana, Ill., where the development work was done in cooperation with the Illinois Agricultural Experiment Station. (Klueter is now stationed at the Agricultural Research Center, Beltsville, Md.)



Feed creates its own airtight seal in the new auger injector, which needs less adjustment than the rotary type (top right).

Adjustments are never necessary on the auger-type injector because its operation does not depend on closely fitting airtight parts. Feed moving through the injector creates its own airtight seal.

Rotary-valve injectors, which need constant attention, work like a revolving door turned on its side. Feed is dropped into the top of the valve and rotated to the bottom, where a stream of air carries it into the pipeline system. Like a revolving door, the rotary valve is most efficient when it is airtight.

The fast-moving feed causes wear on close-fitting parts, and the unit loses its airtight seal. Adjustments are often necessary after processing less than 200 tons of feed. Following two or three adjustments, the worn parts must be replaced. These cost almost as much as the entire auger-type injector.

The engineers don't know how many tons of feed the new auger will move before needing replacement, but they anticipate the amount will greatly exceed that moved by the rotary valve. Puckett is now running wear tests on an auger injector installed in a feed pipeline system on an Illinois farm. The injector is part of an overall feeding system that automatically grinds, mixes, conveys, and distributes feed to livestock. (See AGR. RES., June 1960, page 8.)

The auger injector could also have wide adaptation in industry, where pneumatic conveying systems are growing in popularity for conveying flour, pulverized coal, cement, and other free-flowing materials. Pneumatic systems are popular in industry because of ease of installation, automatic controls, the small diameter pipe required, and the limited amount of dust that is generated at discharge points. The engineers say several manufacturers have shown an interest in the new injector unit.

One Illinois farmer has built his own auger feed injector, using the new design. His injector and conveyor system save the wages of one part-time man who would otherwise be required to distribute the feed.☆

Behavior of Pesticides in Soils

New Beltsville laboratory employs latest techniques in intensified studies

■ Exactly how long does a pesticide remain active in the soil? How and to what extent does it spread while still active? And what finally happens to it?

Answers to these questions are being sought by scientists at a new ARS laboratory at Beltsville, Md., devoted to investigations of pesticides in soils.

The newly completed lab is another step in USDA's broad study of factors affecting the behavior of pesticides. Another lab, under construction at Fargo, N. Dak., will be devoted to studying metabolism of chemicals in plants, animals, and insects.

Some research of this type has been carried out in the past at Beltsville, in widely scattered locations by various State experiment stations, and by laboratories of pesticide manufacturers. Four highly trained scientists now are teamed up to work solely on pesticide-soil problems in a concentrated and coordinated program. T. J. Sheets, plant physiologist, heads the ARS research team. Others are P. C. Kearney, biochemist; D. D. Kaufman, microbiologist; and C. I. Harris, soil scientist.

Their research will furnish information that will assist scientists in establishing recommendations for use of herbicides, insecticides, fungicides, and nematocides. Following the recommendations will, in turn, help prevent harmful pesticide residues in soils or plants.

Pesticides are applied in various ways—directly to the soil, under the soil surface, and as foliar sprays. Regardless of the method of application, at least part of the pesticide eventually reaches the soil.

The study of the active life of these pesticides in the soil is therefore a vital part of the USDA's overall research program.

The work will encompass the effects of light, water, temperature, and other factors on pesticides in soils. Soil

ABOVE—Radioactive material is used in the isotope counting room of the new laboratory to make precise measurements. Biochemist P. C. Kearney operates a strip scanner—equipment that determines the precise location of radioactive compounds on paper chromatograms. The unit at right counts or measures radioactivity in soil and in extracts of soils containing labeled pesticides.

LEFT—Scientists observe plant growth at the pesticide behavior laboratory as one way to judge the amounts of herbicides present in soils. Examining oat plants for retardation are plant physiologist T. J. Sheets (left), who heads the ARS laboratory, and technician M. L. Beall. In the foreground are sections of leaching columns that have been planted to oats. By noting growth retardation, the scientists can determine how far a given chemical leaches into a column of earth.

systems vary greatly in composition. They have their own atmospheres and continually undergo intricate changes. This complexity makes the study of the behavior of pesticides meticulous and time-consuming.

Residues will be measured by various methods to determine the movement, persistence, and fate of pesticides. Radioactive materials will be used to trace and measure the movement of chemicals and the changes in their molecular structure.☆

An oversized shaker handles the large number of flasks used in experiments. It was designed and built by microbiologist D. D. Kaufman and design engineer J. F. Mullins. Operating the unit is S. L. Hastings, laboratory technician.

A Soxhlet extractor, operated by laboratory technician J. W. Smith, removes pesticides from soil samples through multiple extractions. The unit can remove certain chemicals that are difficult or impossible to extract by usual methods.

Measuring Seepage on Sites for Reservoirs and Ditches

■ An improved method devised by an ARS scientist may open the way for solving a problem that has long challenged engineers—how to take a field measurement of the velocity at which water moves through saturated soil above a water table.

This measurement, called the hydraulic conductivity of the soil, is needed for evaluating seepage problems on sites being considered for reservoirs, irrigation canals, and ditches. Accurate measurement previously could be made only after flooding the soil, but inundation of such sites seldom is practical.

The procedure, devised by hydraulic engineer H. Bouwer, is also a valuable research tool in studies of water movement in soil.

The method consists of (1) inserting two concentric tubes in a properly cleaned auger hole dug to the desired depth in undisturbed soil, (2) filling the tubes with water and saturating a limited soil area below the hole, (3) measuring the subsequent rate of water-level change in the inner tube after the desired saturation point is reached, and (4) calculating conductivity from the measurements. The water in the outer tube, acting as a barrier, prevents horizontal movement of water from the inner tube. The change of water level in the tube, therefore, represents seepage downward through the saturated soil.

The calculations are made by using algebraic equations that express the various characteristics affecting hydraulic conductivity. In determining the equations, Bouwer employed electrical current to simulate water flow.

The double-tube method of determining hydraulic conductivity of the soil is partially an outgrowth of earlier research by Bouwer on the development of a seepage meter at the U.S. Water Conservation Laboratory, Tempe, Ariz.

Bouwer confirmed the accuracy of the new method in a laboratory sandbox filled with material of known hydraulic conductivity. In this experiment, the conductivity rate obtained with the double-tube method (3.87 centimeters per minute) agreed closely with the rate obtained when water was circulated throughout the sandbox (4.10 c.p.m.).

Bouwer says the slightly lower conductivity with the double-tube method was probably due to compaction around the tube when it was placed in the sandbox.

In other laboratory determinations, on soil samples secured from the auger hole after the field tests, conductivity rates compared satisfactorily.☆

Cobalt-deficient soils are studied by ARS and the Soil Conservation Service as an aid in mapping problem areas.

Mineral Elements, Co - Mo - Se

Study relates micronutrient disorders to forage and to soils on which forage grew

■ In colonial times, farmers in parts of New England could not understand why cattle that appeared to be starving refused to graze lush pastures. Some of the colonists blamed a curse they said was placed on their land by Chocorua, an Indian chief.

We know now that these animals suffered from cobalt deficiency, one of several mineral nutritional disturbances of animals under investigation at the U.S. Plant, Soil, and Nutrition Laboratory, Ithaca, N.Y. Though we have considerable knowledge today about these problems, there are still many unanswered questions.

ARS scientists at Ithaca are studying the relationship of these disorders to the forage eaten by animals and to the soils on which the forage grew. This research is in cooperation with the Cornell University Agricultural Experiment Station and experiment stations in States where specific problems are encountered. USDA's Soil Conservation Service cooperates in many of the field investigations.

Too little or too much

Some nutritional disturbances develop in animals when too little of a mineral is present in their rations. A shortage of cobalt, for example, interferes with growth of cattle and sheep. In other instances, an element may cause nutritional disturbances in animals when it is present in excess amounts in feeds. Thus, when animals eat forage containing too much molybdenum, scouring may result. Too little selenium causes certain disorders, and too much is responsible for others.

The mineral nutritional problems under study at Ithaca include—

COBALT—Recent studies indicate that the major cobalt-deficient areas in New England are located on soils developed on granitic glacial drift originating in the White Mountains of New Hampshire. About 500 forage samples, collected from 250 soil sites, were analyzed to accurately define these areas.

Scientists are now preparing maps that identify cobalt-deficient areas. Farmers in these areas can use feeds supplemented with trace amounts of cobalt or apply cobaltized fertilizers to the soil. The amount of cobalt required for healthy animals is very small—less than 2 ounces in 500 tons

LEFT—Forage and soil samples are taken for laboratory analysis in mineral-deficient areas. The studies help determine the micronutrient level at which deficiency or toxicity occurs.

LOWER LEFT—Molybdenum-copper nutritional disturbances result in failure of animals to gain weight, scouring, weakness, rough hair coat, and faded hair color.

BELOW—Small amounts of selenium are measured by burning a plant sample in an oxygen-filled flask, then analyzing the resulting substance with a photoelectric fluorometer.

of hay. But without cobalt, raising cattle and sheep is impossible.

MOLYBDENUM—Research at Ithaca and by the cooperating Nevada Agricultural Experiment Station is defining the circumstances under which molybdenum toxicity occurs. The scientists have conducted surveys to identify areas where plants contain sufficient molybdenum to be detrimental to cattle and sheep. Forage that tests high in molybdenum content is often produced on poorly drained sandy soils derived from granitic alluvium.

The Nevada scientists showed that the degree of molybdenum toxicity is influenced by the ration received by livestock. The same amount and form of molybdenum was more toxic to beef cattle on fresh green forage than to cattle on dry hay. This finding substantiates the belief of ranchers that some pastures can be safely cut for hay even though cattle grazing these pastures will suffer from molybdenum toxicity.

Interferes with Copper

Molybdenum toxicity affects the animals by interfering with the normal functions of copper in their systems. Cattle can be protected from molybdenum toxicity by injections of certain copper compounds.

SELENIUM—Scientists at the Plant, Soil, and Nutrition Laboratory are seeking to identify U.S. areas where selenium is deficient in soils and plants. Their research is an outgrowth of studies in this country and New Zealand showing that as little as 0.1 part per million of selenium in lamb rations prevents muscular dystrophy (white muscle disease).

The researchers are growing plants in the greenhouse—under carefully controlled conditions of selenium supply—in order to study the process of selenium uptake by plants. They hope to produce plants containing less than the minimum amount of selenium needed by animals. Then they will study the effect of feeding these selenium-deficient plants to laboratory animals.

In earlier research, USDA and State scientists studied livestock nutritional disturbances resulting from toxic amounts of selenium. Maps were made showing areas where plants contain sufficient selenium to be toxic to animals.☆

Fall Spraying of Boll Weevils

Wide-scale field tests are effective in the Southwest

■ Large-scale spraying of cotton with methyl parathion during the fall has controlled boll weevils in Southwest field tests. This treatment prevents the insect from reaching the diapause stage of its development.

It is in this stage that boll weevils are conditioned for hibernation and overwintering. The insects become sluggish, cease breeding, and store up body fat to sustain them until spring. After completing diapause, the weevils migrate into nearby woody areas where they are inaccessible to treatment.

Although the inducements to diapause are not completely understood, the scientists believe this development stage may be linked with day length, temperature, and maturing of the cotton plant.

The field tests were conducted in the Presidio-El Paso Valley area of Texas and Mexico in 1961 and 1962. ARS entomologists worked in cooperation with the Texas Agricultural Experiment Station and Department of Agriculture, the National Cotton Council, and the Mexican Department of Agriculture.

Treatment doesn't kill all weevils

The fall treatment does not kill all the weevils. Some go into hibernation and emerge in the spring to reproduce and reinfest cotton fields. Researchers therefore believe that spring treatments also are needed to eliminate weevils that survive the winter. They say a combination of fall and spring treatments—if done by all growers over a large area—might achieve eradication.

The spraying, involving about 1,500 acres of cotton land, followed successful smaller area experiments in Texas, Louisiana, Mississippi, and South Carolina.

ARS entomologist W. H. Cross, State College, Miss., supervised the 1961–62 Presidio-El Paso Valley field trials. The fall treatments against diapausing boll weevils not only reduced the number of weevils going into hibernation but resulted in complete seasonal control in most of the fields. Eradication of the insect, however, was not achieved.

The researchers found that precise timing of the methyl parathion application is essential. Since all the weevils do not begin diapause at the same time, the insecticide must be applied

every 10 to 14 days, from the first indication of diapause until frost.

Controlled weevils until July

In 1959, an almost complete kill of boll weevils was achieved with fall spraying on 525 acres in the Presidio-El Paso Valley. Four sprays of methyl parathion were applied at 10- to 14-day intervals just before the first killing frost. No weevils were found in treated fields until the following July, when a small infestation was discovered. These weevils may have come from an untreated area nearby.

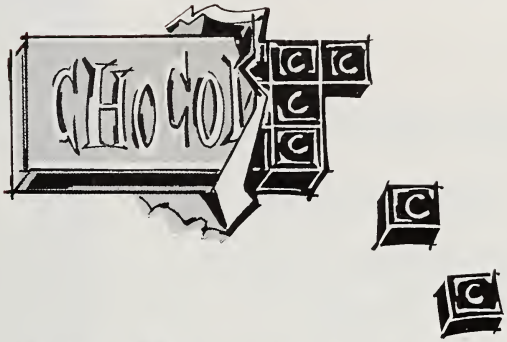
After reviewing these findings, the scientists concluded that they were not yet ready to recommend fall spraying to growers. The results, however, did seem to justify large-scale experiments in various areas.

The earlier experiment was also designed to test the value of insecticidal treatments against diapausing weevils as a way to prevent spread of the insects to noninfested cotton-producing areas of the irrigated West.

Concern over spread of weevils

Since 1953, when boll weevils were first reported in the lower Presidio Valley, they have advanced 120 miles up the Rio Grande River toward El Paso, Tex. This infestation apparently originated in the irrigated cotton areas of North Central Mexico. Scientists are concerned that the insects may spread to west Texas, New Mexico, Arizona, and California, where boll weevils have not been a problem.

The diapause phenomenon in the boll weevil was discovered in 1957 by Louisiana Agricultural Experiment Station entomologists J. R. Brazzel and L. D. Newson. Brazzel, now at the Texas Agricultural Experiment Station, directed diapause-control experiments in Texas during the past 2 years.☆



Simplified Technique Speeds Chocolate Tempering Process

■ Cooperative research by ARS and the National Confectioners Association has resulted in an improved method of tempering confectionery chocolate that may mean increased automation and greater economies in the candy industry.

Investigations at the Southern utilization research laboratory in New Orleans show that this new tempering process can eliminate the troublesome and time-consuming methods now used to make chocolate products that will remain stable during shipment and storage.

The process was worked out by R. O. Feuge, N. V. Lovegren, and D. Mitcham, ARS chemists, and W. Landmann, National Confectioners Association Fellow. An application for a public service patent has been filed with the U.S. Patent Office.

When confectionery fats harden, they can solidify in one of four crystal forms, each with its own melting point. Confectioners want chocolate with a high melting point because it is dense and stable.

The three tempering techniques now used involve (1) "seeding" the melted chocolate with aged chocolate, (2) holding the chocolate in special kettles at a temperature just below its melting point, or (3) aging the finished product at a controlled temperature.

The scientists hypothesized that the step-by-step procedures required in these tempering techniques might be bypassed. They decided to try to make the fat molecules arrange themselves into the desired dense pattern by mechanically working quickly solidified chocolate crystals.

The resulting new process involves forcing untempered chocolate through a press equipped with tiny holes similar to those in a shower head. The scientists found that pressing and extruding the chocolate a number of times caused the sought-after type of fat crystal to develop rapidly.

To make the liquid fat harden immediately to the most desirable crystal form, the researchers heated chocolate to 160° F. to destroy all crystal nuclei, then cooled it rapidly. The hardened fat was forced through the press repeatedly at pressures up to 1,000 pounds per square inch. With each extrusion the chocolate became harder. After the tenth extrusion, the chocolate was partially remelted and solidified in molds. This produced chocolate bars that behaved in every respect like conventionally processed chocolate. Chemical analysis showed the chocolate to be in the desired crystal form.☆

Protein-Short Rations . . .

Their effect on feed consumption

■ An inadequate amount of protein drastically reduces the feed consumption of cattle, ARS scientists found in a feeding study at the Agricultural Research Center, Beltsville, Md.

Cattle ate about 16 pounds of feed a day when their rations contained adequate protein, plus carbohydrate and other digestible nutrients at the recommended level. On low-protein rations, daily feed consumption dropped more than 37 percent—to about 10 pounds. The low-protein rations contained half the recommended amount of protein.

The low-protein rations included either cornstarch or sugar, plus poor-quality grass hay, corn and cob meal, molasses, salt, bonemeal, and vitamin A. To this ration was added cottonseed meal or urea to convert it to an adequate-protein ration.

Liked cornstarch, then sugar

Cattle were permitted to eat as much of a given ration as they wanted. They showed a slight preference for the cornstarch diet in the low-protein tests. But as the protein level was increased, the cattle ate more of the feed containing sugar than of the one containing cornstarch.

Since the only variable was the added protein, the scientists say the cattle apparently changed their preference from cornstarch to sugar as the protein level was increased.

In testing the rations containing the adequate level of protein, the scientists also found that cattle gained the most weight on the feed that contained cornstarch and urea.

The study was conducted by animal husbandman James Bond and associates at the Beltsville center.☆

Heifers Get Hormones . . .

A study on controlling birth dates

■ How to raise the normally low conception rates of heifers that have been bred during artificially induced heat periods is a problem ARS and Nebraska scientists are trying to solve.

Heat periods have been synchronized experimentally by injecting the sex hormone progesterone, an accomplishment that has much potential value to livestock breeders. It would mean that calves could be born about the same time and marketed in uniform age groups.

But many animals given progesterone don't conceive when bred—probably, the scientists believe, because progesterone lowers fertility by upsetting the female's hormone balance. In research at Fort Robinson, Nebr., scientists apparently restored this balance by injecting a second hormone, estradiol, along with the progesterone.

Conception rates among some of the heifers injected with the two hormones have been almost as high as conception rates in heifers that were bred while in natural heat.

A group of heifers given the two hormones had a conception rate of 56 percent compared with a 40-percent rate for a group injected with progesterone only. Heifers in normal heat had a 60-percent rate of conception.

The study was conducted by J. N. Wiltbank, animal husbandman of ARS, and D. G. Lefever, animal husbandman, and D. R. Zimmerman, animal physiologist, of the Nebraska Agricultural Experiment Station.

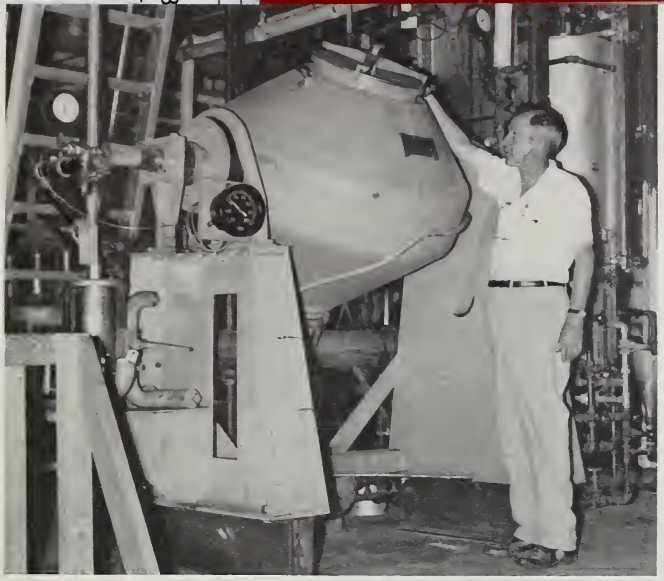
Heifers received daily injections

They gave the heifers daily injections of the hormones for 24 days.

Most successful for bringing the heifers in heat—within 3 to 7 days after injections ceased—was 40 milligrams of progesterone plus varying amounts of estradiol (20, 40, or 80 micrograms). Only 2 of 59 heifers getting these injections failed to come in heat during that time. Progesterone alone was almost as effective for inducing heat—only 5 of 40 heifers getting progesterone injections failed to come in heat during the specified 7-day period.

Conception rates were highest (56 percent) when 40 mg. of progesterone were injected with 80 mcg. of estradiol. They were lowest (13 percent) when 40 mg. of progesterone were injected alone. Twenty mg. of progesterone resulted in a 37-percent conception rate.

Before making recommendations for field use, the scientists want to check the double-hormone injections on a large number of animals.☆



IMPROVED COTTONSEED MEAL

New extraction method removes nearly all gossypol

■ ARS scientists have developed a cottonseed oil extraction method that removes most of the toxic pigment gossypol along with the oil, leaving a higher quality meal for livestock feed. The gossypol is later removed from the oil during refining.

For more than 50 years, oilseed processors and the feed industry have recognized that this pigment restricts the use of cottonseed meal as a protein supplement for swine and poultry.

Gossypol, which is toxic in its "free" or available form in cottonseed meal, has stubbornly resisted efforts to extract it along with cottonseed oil or to counteract its effects satisfactorily. Simply heating the meal reduces the pigment's harmful effects, but this chemically binds it to lysine, an essential protein constituent, which then becomes unavailable as a nutrient.

Acetone, hexane, and water

The new extraction method, which uses a mixture of acetone, hexane, and water, was worked out by ARS chemists V. L. Frampton and W. H. King at the Southern utilization research laboratory, New Orleans.

The chemists knew that hexane, normally used to extract oil from cottonseed, removes only a small part of the gossypol. They also knew that a mixture of water and acetone would remove the gossypol but would not readily extract the oil. They decided to try a mixture of all three.

The new extraction method left a high-quality meal containing as little as 0.2 percent of total gossypol and 0.02 percent of free gossypol. Available lysine, an index of meal quality, was 4.2 percent of the protein. Available lysine in commercial meals usually ranges from 2.8 to 4 percent, averaging about 3.6 percent. Residual oil in the experimental meal was below 0.5 percent.

Use of the 3-solvent mixture had no adverse effect on the quality of the oil. Practically all the gossypol was removed during the oil-refining process.

Encouraging results have been obtained in limited feeding tests, conducted at Louisiana State University, in which chicks were fed meals produced in small batches with the mixed solvents. Weight gains in chicks fed these meals averaged about 34 grams in a 2-week period. Chicks fed heat-treated meals averaged gains of only 23 grams in the same period.

In applying the process to a pilot-size operation, ARS chemical engineers E. A. Gastrock and E. L. D'Aquin are working to adapt it so that present equipment in oilseed-processing mills can be used with as few changes as possible to the mill equipment.

Remaining problems under study

Among the problems in the pilot-plant work are preparation of the seeds for extraction, removal of all traces of solvents from both oil and meal, and the development of a system to recapture and control the solvents. The engineers point out that these problems may not be unduly complex.

About 3,000 pounds of cottonseed meal samples have been produced in the pilot plant. Different solvent mixtures were used. In all these runs, the total gossypol content of the meals ranged from a low of 0.2 percent to a high of 0.5 percent. Free gossypol ranged from 0.02 to 0.07 percent, and available lysine from 3.93 to 4.22 percent. Residual oil in the meals ranged from 0.4 to 0.9 percent. These percentages indicate that all the experimental meals would make good high-protein feed supplements.☆

WEATHER RECORDING Around the Clock

Fully automatic weather station records a dozen elements every 30 minutes

■ A completely automatic weather station is now in operation at Athens, Ga., recording a dozen weather elements around the clock. It is believed to be the first fully automatic station devoted exclusively to agriculture.

The station is primarily responsible for recording data from ARS research on solar heating for farmhouses, but agronomists and soil scientists will also use the weather information in studies with various types of ground covers.

Two ARS agricultural engineers, B. C. Haynes, Jr., and J. W. Simons, designed and built the field weather station at the University of Georgia in cooperation with the Georgia Agricultural Experiment Station. The automatic equipment reduces cost of recording and minimizes errors.

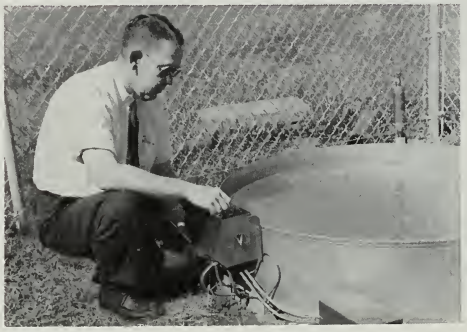
Here are some of the elements the equipment will record: Temperature (dry bulb and dew point), wind speed and direction, radiation from the sun, difference between ground and sky radiation, evaporation, rainfall, soil temperature and moisture, and black globe temperature. (Black globe temperature is the combined measurement of heat radiation, air temperature, and wind movement.)

Wind measured 20 feet up

Data about the various elements are sensed by instruments located outdoors and recorded on electronic equipment housed in a small building nearby. For example, wind speed and direction are measured by an outdoor anemometer and vane positioned some 20 feet above the ground. The instruments are wired to the equipment in the building to record data.

Every 30 minutes, all weather and soil data and the date and time of day are accurately recorded on data-processing cards. The recording takes only a few seconds. To record such information manually—even once or twice a day—would require that someone maintain the equipment and take readings every day. The automatic equipment operates around the clock, day after day, without attention.

The punched cards are periodically collected and run through a computer, which translates the data into easy-to-read form.☆



LEFT—B. C. Haynes, Jr., sets controls on equipment that measures water evaporation. MIDDLE—Sensing instruments collect information about weather and soil conditions, transmit it into station. BOTTOM—J. W. Simons checks weather data received on the automatic computer and recording equipment.

AGRISEARCH NOTES

Bigger calf crop from heifers

Here are four rules to help cattlemen get the best calf crop from heifers calving for the first time:

(1) Choose heifers that were heaviest at weaning. (2) Breed them to bulls that tend to sire small calves. (3) Don't overfeed bred heifers. (4) Put the heifers on good spring pasture after they calve.

The rules are based on research by ARS animal husbandman J. N. Wiltbank and associates at the Fort Robinson, Nebr., Beef Cattle Research Station, operated by ARS in cooperation with the Nebraska Agricultural Experiment Station.

In this research, less than 15 percent of the heavy heifers had trouble

calving, whereas more than a third of the small heifers needed assistance, had stillbirths, or retained the afterbirth.

A third of the heifers carrying large calves—those weighing over 80 pounds at birth—had difficulty calving. But only a tenth of the heifers producing smaller calves had difficulty.

Feeding a high-energy ration shortly before calving caused more than half of the heifers to lose their offspring at birth. On a medium-energy ration, the loss rate was only 4 percent.

Heifers are often slow returning to heat after calving for the first time, but a good early-spring pasture like crested wheatgrass will speed them up. During the first three weeks on crested wheatgrass at Fort Robinson, 71 percent of the heifers came in heat again and mated. This contrasts with only 43 percent of the heifers on native grasses. On the average, heifers on crested wheatgrass came back in heat 8 days earlier.

U.S. source of cortisone found

An easy way has been found to propagate Central American yams, a plant source of cortisone and other drugs.

The propagated plants will be used in large-scale field studies to determine whether this foreign yam can be cultivated here. Limited preliminary trials indicate that it can. If large-scale trials bear this out, the yam could become a new crop in some parts of the South, providing not only a domestic source of steroid compounds but also additional income to farmers.

Extensive agronomic studies of the Central American yam (genus *Dioscorea*) have long been blocked by the lack of a practical way to propagate the plants in sufficient numbers for field trials. The wild yams are now collected by Central Americans, then partially processed for exportation to the U.S. as raw material.

The method of propagation was developed by ARS horticulturists W. H. Preston, Jr., and J. R. Haun at the Plant Introduction Station, Glenn Dale, Md. The scientists used juvenile shoots from plants not large enough to produce climbing vines. These shoots can be easily identified by their rosette habit of growth.

By propagating the juvenile shoots in mist, the scientists consistently obtained 95 to 100 percent rooting, compared with 0 to 15 percent when mature climbing vines were used for propagation.

ARS and several State agricultural experiment stations are now planning field trials to test *Dioscorea's* performance as a cultivated crop. About 15,000 plants have been distributed to test locations, and 15,000 more will be shipped this spring.

Older rams dominate young rams

An old ram may interfere with flock improvement by dominating a younger ram that has superior genetic qualities but a subservient nature.

As a result, a majority of the ewes in large pens—and nearly all in small pens—may be bred by the older, inferior male, thereby limiting the flock's genetic progress.

ARS animal physiologist C. V. Hulet and associates found such a pattern of ram social dominance in studies at the U.S. Sheep Experiment Station, Dubois, Idaho. The tests were made in cooperation with the University of Idaho.

When put in a breeding pen with ewes and a yearling ram, an older

male mated many more ewes than the young ram mated. Competition between the two males, however, reduced the total breeding efficiency of both; just as many ewes were bred when either ram was in the pen alone with the ewes.

Hulet therefore concludes that under most conditions a large flock should be subdivided into single-sire groups or at least into groups with sires of the same age.

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AGRISEARCH NOTES

Cage floors reduce egg losses

Egg breakage in turkey laying cages is reduced from 10 percent to less than 1 percent by using ARS-developed cage floors instead of conventional ones.

The new floor, designed for Beltsville Small White turkeys, is constructed of flattened, plastic-coated wire. The wires are three-fourths of an inch apart and run lengthwise of the cage (the direction eggs roll when the floor is in place). Supporting cross wires beneath these lengthwise wires are spaced about 4 inches apart.

The new floor, developed and tested by ARS poultry physiologist M. W. Olsen and agricultural engineer L. M. Lucas, is being used in all turkey laying cages at USDA's Agricultural Research Center, Beltsville, Md.

In tests there, only 46 of 7,783 eggs cracked when laid in cages with the new floors. In contrast, 768 of 7,901 eggs cracked in cages with conventional floors.

The new turkey cage floor costs slightly more than conventional floors. But the increase in eggs hatched, especially when valuable breeding stock is involved, may more than offset this added construction cost.

Although commercial turkey egg producers don't use laying cages, breeders often use individual cages for hens to assure the identities of valuable offspring.

Sansevieria has been developed by ARS and the Florida Agricultural Experiment Station as a promising domestic source of fiber for rope and twine, now made from manila hemp. Sansevieria (center) combines the ease of propagation of its Florida parent, S. trifasciata (left), commonly called snake plant, with the cold tolerance of its Ethiopian parent, S. deserti (right). The sansevieria hybrid is started from leaf cuttings. It is a rapid grower and produces very high yields.

New cotton blight races

Ten new races of the bacterium of cotton blight have been isolated and described by L. A. Brinkerhoff, ARS plant pathologist, working in cooperation with the Oklahoma Agricultural Experiment Station. They are the first new races isolated since 1956.

Brinkerhoff's study also shows that breeding lines of cotton carrying the blight-resistant B_2B_6 combination of genes are resistant to the new races and the two races previously known.

Blight affects all cotton-growing areas, but it is particularly destructive in the Southwest. Losses of the high-quality cotton there have run as high as 25 percent in some years.

To offer a wide range of resistance to the disease, ARS cotton researchers are building up a backlog of blight-resistant breeding lines that include the B_2B_6 combination of genes.

Once resistance to known races and other desirable characteristics such as high yield have been bred into a cotton variety, its continued success will depend on its ability to withstand new races of blight bacterium.

Correction: EPTC versus beans

The soybean graph on page 12 of the December 1962 issue was in error. The data in this graph referred to field beans, not soybeans. The article itself, on the same page, correctly states that *EPTC should not be used* for controlling weeds in soybeans, lima beans, or blackeye peas.

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